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(54) POSITION DETECTION METHOD FOR OPTICAL DISPLACEMENT METER AND OPTICAL DISPLACEMENT METER USING THIS METH0D

(57)Abstract:

PURPOSE: To detect displacement accurately and stably with an optical displacement meter without using a multitude of comparators or accurate comparators.

CONSTITUTION: Each of a pair of position signals output from a position detection element 105 is amplified with an amplifier selected among a plurality of amplification factors set up in advance. Each amplification factor is simultaneously increased or decreased in turn so that the sum signal of the pair of amplified signals is in the window level specified by the determined maximum level EH and the minimum level EL capable of processing the signal.

CLAIMS

[Claim(s)]

[Claim 1]It is a position detection method used for an optical displacement meter which receives light by a position detecting element which outputs modulated light towards an object from a light emitting deviceand outputs a position signal of a couple [catoptric light / by an object] according to a light-receiving positionand measured the objective amount of displacementEach of a position signal of a couple outputted from the above-mentioned position detecting element is amplified with an amplification factor selected from two or more amplification factors set up beforehanda position detection method of an optical displacement meter characterized by making it increase or reduce an amplification factor of each above one by one simultaneously so that a summed signal of a position signal of an amplified couple may enter in a window level which becomes settled in a predetermined maximum level and a minimum level in which signal processing is possible.

[Claim 2]An optical displacement meter which receives light by a position detecting element which outputs modulated light towards an object from a light emitting deviceand outputs a position signal of a couple [catoptric light / by an object] according to a light-receiving positionand measured the objective amount of displacementcomprising:

1 set of variable amplifiers which amplify individually each of a position signal of a couple outputted from the above-mentioned position detecting element with an amplification factor selected from two or more amplification factors set up beforehand.

An adder circuit adding a position signal of a couple amplified in this variable amplifier.

A level discrimination section which distinguishes whether it enters in a window level in which the above-mentioned summed signal becomes settled in a predetermined maximum level and a minimum level in which signal processing is possible.

When the above-mentioned summed signal exceeds the above-mentioned

maximum level according to a discrimination signal which was defined beforehand and which is outputted from the above-mentioned level discrimination section for every given periodan amplification factor control section to which an amplification factor of a variable amplifier of each above is made to increase from the present amplification factor by simultaneously by one step when the above-mentioned summed signal falls from the above-mentioned minimum levelwhile reducing an amplification factor of a variable amplifier of each above simultaneously by one step from the present amplification factor.

[Claim 3]It is a position detection method used for an optical displacement meter with the feedback loop of an optical system which receives light by a position detecting element which outputs modulated light towards an object from a light emitting deviceand outputs a position signal of a couple [catoptric light / by an object] according to a light-receiving positionand measured the objective amount of displacementEach of a position signal of a couple outputted from the above-mentioned position detecting element is amplified with an amplification factor selected from two or more amplification factors set up beforehandAn error integration signal which searched for and searched for an error integration signal as compared with predetermined reference level a summed signal of a position signal of an amplified couple so that it may enter in a window level which becomes settled in a predetermined maximum level and a minimum level in which signal processing is possiblea position detection method of an optical displacement meter it was made to increase or reduce an amplification factor of each above one by one simultaneously.
[Claim 4]An optical displacement meter characterized by comprising the following with the feedback loop of an optical system which receives light by a position detecting element which outputs modulated light towards an object from a light emitting deviceand outputs a position signal of a couple [catoptric light / from an object] according to a light-receiving positionand measured the objective amount of displacement.

1 set of variable amplifiers which amplify individually each of a position signal of a couple outputted from the above-mentioned position detecting element with an amplification factor selected from two or more amplification factors set up beforehand.
An adder circuit adding a position signal of a couple amplified in this variable amplifier.
An error integration circuit which integrates with a part for the error as compared with reference level which was able to define the above-mentioned summed signal beforehand.
A level discrimination section which distinguishes whether it enters in a window level in which the above-mentioned error integration signal becomes settled in a predetermined maximum level and a minimum level in which signal processing is possible.
When the above-mentioned error integration signal exceeds the above-mentioned maximum level according to a discrimination signal which was defined beforehand and which is outputted from the above-mentioned level discrimination section for every given periodan amplification factor control section which reduces an amplification factor of a variable amplifier of each above simultaneously by one step from the present amplification factor when the above-mentioned error integration signal falls from the above-mentioned minimum levelwhile making an amplification factor of a variable amplifier of each above increase from the present amplification factor by one step.

[0001]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Industrial Application]This invention relates to the optical displacement meter

using the position detection method with which the optical displacement meter was improvedand this method.

[0002]

[Description of the Prior Art]Modulated light is outputted towards an object from a light emitting deviceand the optical displacement meter which receives the catoptric light by an object by a position detecting elementand measured the objective amount of displacement has come to be developed and used. Drawing 10 is what showed the example of an internal configuration of such an optical displacement meter 100synchronizing with the pulse outputted from the oscillating circuit 101a modulating signal is transmitted to the laser diode driver 103 from the modulation circuit 102and a laser beam is outputted to an object from the laser diode 104. Thenthe position signal I1 of the couple according to the position in which the laser beam reflected by the object entered into the position detecting element 105and I2 are outputtedand this position signal I1 and I2 are amplified in the amplifying circuit 106107 and the variable amplifier 108109and it restores to them in the signal processing part 110111. Then(I1-I2) is calculated in the subtractor circuit 112(I1+I2) is calculated in the adder circuit 113(I1-I2)/(I1+I2) is called for in the ratio circuit 114it is transmitted to the output circuit 115and the objective amount of displacement is measured by this operation.

[0003]By the wayin order to stop the breadth of the dynamic range of the demodulation signal transmitted to the subtractor circuit 112the adder circuit 113and the ratio circuit 114 in this optical displacement meter 100 and to raise arithmetic precisionAdd the output signal of the amplifying circuit 106107 in the adder circuit 116rectify a summed signal in the rectification circuit 119and it transmits to the level discrimination section 117Negative feedback control is performed so that the amplification factor of the variable amplifier 108109 may be controlled by the amplification factor control section 118 according to the level of a summed signal and a summed signal level may become constant value.

[0004]That isas shown in drawing 10they are each comparators 117a and 117b

of the level discrimination section 117... It has 117 n of reference voltage of Ea and Eb...En respectively.
As shown in drawing 11when the summed signal level E increasesSo that the amplification factor Ga and Ec<E<Ee may make the amplification factor Gbit may become the amplification factor Gc in Ee<E<Eg and it may become the amplification factor Gd at Eg<E<Eh in Ea<E<EcWhen the summed signal levels E decrease in numberFor the amplification factor Gd and Ef>E>Ed to make the amplification factor Gcto become the amplification factor Gb in Ed>E>Eband to become the amplification factor Ga in Eb>E>Eaa hysteresis characteristic is given and the amplification factor of the variable amplifier 108109 is controlled by Eh>E>Ef by the amplification factor control section 118.

[0005]Thereforeas shown in (a) - (c) of drawing 12it synchronizes with a clock signal (output signal of the oscillating circuit 101)Negative feedback control is performed so that the position signal I1 and I2 may be amplified with the amplification factor (refer to drawing 10) which asked for the level range of the summed signal and was defined according to the range for which it asked from the discrimination signal of each comparator of the level discrimination section 117 and a summed signal (I1+I2) may always become constant value.
[0006]Howeverin the optical displacement meter 100 of such composition. As the dynamic range of the summed signal outputted from the adder circuit 116 was shown in drawing 11in order that the wide range of tens of volts may be covered from several millivoltsmany amplification factors must be set up in the variable amplifier 108109 -- this sake -- the level discrimination section 117 -- many comparators 117a and 117b ... being requiredandsince the dynamic range is largeIn the comparator of the lowa circuit design -- high degree of accuracy is required -- was made difficult.
[0007]
[Problem(s) to be Solved by the Invention]By making this invention in light of the above-mentioned circumstancesand controlling so that the summed signal of the

position signal of a couple enters in a predetermined window levelIt aims at providing the position detection method which can perform highly precise and stabilized displacement detectioneven if it does not use many comparators or highly precise comparators. An object of this invention proposed simultaneously is to provide the optical displacement meter which used this position detection method.

[0008]

[Means for Solving the Problem]To achieve the above objectsthis invention method according to claim 1 proposedEach of a position signal of a couple outputted from a position detecting element is amplified with an amplification factor selected from two or more amplification factors set up beforehandhe is trying for an amplification factor of each above to be simultaneously increased or reduced one by one by summed signal of a position signal of an amplified couple so that it may enter in a window level which becomes settled in a predetermined maximum level and a minimum level in which signal processing is possible

[0009]An optical displacement meter of this invention according to claim 2 is what used this invention method according to claim 11 set of variable amplifiers which amplify individually each of a position signal of a couple outputted from a position detecting element with an amplification factor selected from two or more amplification factors set up beforehandAn adder circuit adding a position signal of a couple amplified in this variable amplifierA level discrimination section which distinguishes whether it enters in a window level in which this summed signal becomes settled in a predetermined maximum level and a minimum level in which signal processing is possibleWhen the above-mentioned summed signal exceeds the above-mentioned maximum level according to a discrimination signal which was defined beforehand and which is outputted from the above-mentioned level discrimination section for every given periodwhile reducing an amplification factor of a variable amplifier of each above simultaneously by one step from the present amplification factorwhen the above-mentioned summed signal falls from the above-mentioned minimum levelit has composition provided

with an amplification factor control section to which an amplification factor of a variable amplifier of each above is made to increase from the present amplification factor by simultaneously by one step.

[0010]In this invention method which this invention method according to claim 3 is a position detection method used for an optical displacement meter with the feedback loop of an optical systemand was indicated to claim 1He is trying to increase or reduce each amplification factor one by one simultaneously so that an error integration signal acquired in a summed signal as compared with predetermined reference level may be entered instead of a summed signal in a window level which becomes settled in a predetermined maximum level and a minimum level in which signal processing is possible.

[0011]Using this invention method according to claim 3in the displacement gage according to claim 2an optical displacement meter of this invention according to claim 4 is replaced with a summed signaland is considered as composition which controls an amplification factor by an error integration signal.

[0012]

[Function]In this invention method according to claim 1control of an amplification factor is performed so that the position signal of the couple outputted from a position detecting element may be amplified and the summed signal of the amplified signal may enter in the window level which becomes settled in a predetermined maximum level and minimum level. For this reasonsince the summed signal of the position signal of a couple is always settled in a predetermined window levelthe breadth of a dynamic range is stopped and the data-processing accuracy for displacement measurement can be raised.

[0013]The summed signal which the position signal of the couple outputted from the position detecting element was amplified in 1 set of variable amplifierswas added in this invention according to claim 2 in the adder circuitand was acquiredIt is distinguished by the level discrimination section whether it goes into the window level which becomes settled in a predetermined maximum level and minimum leveland the discrimination signal is outputtedand in an amplification

factor control section. When a summed signal exceeds a maximum level with reference to the discrimination signal of a level discrimination section for every given periodWhile reducing the amplification factor of each variable amplifier simultaneously by one step from the present amplification factorwhen a summed signal falls from a minimum levelthe amplification factor of each variable amplifier is made to increase from the present amplification factor by simultaneously by one stepand it controls by this so that a summed signal always enters in a window level. For this reasonin a level discrimination sectionwhile what is necessary is just to distinguish a maximum level and a minimum level and being able to reduce the number of comparatorsa highly precise comparator becomes unnecessary.

[0014]In this invention method according to claim 3each of the position signal of the couple outputted from a position detecting element is amplifiedControl of an amplification factor is performed so that it may enter in the window level in which the error integration signal which searched for the error integration signal and searched for the summed signal of the amplified signal as compared with reference level becomes settled in a predetermined maximum level and minimum level. For this reasonsince the error integration signal of a summed signal is always settled in a predetermined window levelas a resulta summed signal will always be settled in a predetermined levelthe breadth of a dynamic range is stoppedand the data-processing accuracy for displacement measurement can be raised.

[0015]In this invention according to claim 4the position signal of the couple outputted from the position detecting element is amplified in 1 set of variable amplifiersand is added in an adder circuitThe acquired summed signal is transmitted to an error integration circuitand an error integration signal is searched forIt is distinguished whether the error integration signal searched for is contained in the predetermined window level by the level discrimination sectionand the discrimination signal is outputtedand in an amplification factor control section. When an error integration signal exceeds a maximum level with

reference to the discrimination signal of a level discrimination section for every given periodWhile making the amplification factor of each variable amplifier increase from the present amplification factor by simultaneously by one stepwhen an error integration signal falls from a minimum levelThe amplification factor of each variable amplifier is simultaneously reduced by one step from the present amplification factorand it controls by this so that a summed signal always enters in a window level. For this reasonin a level discrimination sectionwhile what is necessary is just to distinguish a maximum level and a minimum level and being able to reduce the number of comparatorsa highly precise comparator becomes unnecessary.

[0016]

[Example]Belowthe example of this invention is described with reference to drawings. Although the operation of (a) - (c) of drawing 1 until it is what had and showed the position detection method of the optical displacement meter of this invention according to claim 1 for the time chartit outputs modulated light towards an object from a light emitting device and it receives the catoptric light by an object by a position detecting element is the same as that of the conventional displacement gageIn this invention methodthe position signal of the couple outputted from a position detecting element is respectively amplified with the amplification factor selected from two or more amplification factors set up discretely beforehandIn [search for the summed signal of the position signal of the amplified coupleand] the input timing of a clock signalIf this summed signal is over the predetermined maximum level EHwill reduce each amplification factor of the position signal of a couple by one step from the present amplification factorand converselyif the summed signal is falling from predetermined minimum level ELNegative feedback control is performed so that each amplification factor of the position signal of a couple may be made to increase from the present amplification factor by one step. For this reasonsince it is controlled to enter in the window level in which the aggregate value of the position signal of a couple always becomes settled in a maximum level and a minimum levelit can suppress

that the dynamic range of an aggregate value spreadsand the arithmetic precision for the amount calculation of displacement can be raised.
[0017]Drawing 2 is what showed the example of important section composition of the optical displacement meter 1 of this invention indicated to claim 2gives the same numerals to the conventional optical displacement meter 100 and identical parts which were mentioned aboveand omits explanation. In a figure10 is a level discrimination section with the comparator 10A which outputs a discrimination signal when the summed signal outputted from the adder circuit 113 exceeds the maximum level EHand the comparator 10B which outputs a discrimination signal when a summed signal falls from minimum level EL.
[0018]The resistance R1 which connects the variable amplifier 12 (13) to the amplifying circuit 12a (13a)R2R3 ... It has come to be able to carry out the switch setting of the amplification factor discretely by carrying out the one drive of FET (F1F2F3 ... Fn) by which Rn was respectively connected to series selectively.
[0019]When 11 is an amplification factor control section with the rotary switch 11a shown equivalent and a clock signal is inputtedIf the discrimination signal is outputted from the comparator 10A exceeding the maximum level EHa summed signalThe control signal for reducing the amplification factor which switches the rotary switch 11a and is set up now by one step is simultaneously sent out to the variable amplifiers 12 and 13On the contraryif a summed signal falls from minimum level EL and the discrimination signal is outputted from the comparator 10BIf the control signal to which the amplification factor set up now is made to increase by one step is simultaneously sent out to the variable amplifiers 12 and 13and minimum level EL and the maximum level EH do [a summed signal] and the discrimination signal is not outputted from the level discrimination section 10Operation which makes the amplification factor set up now without switching the rotary switch 11a hold as it is is performed.
[0020]Thussince the summed signal outputted from the adder circuit 113 by the two comparators 10A and 10B of the level discrimination section 10 is supervising entering between the maximum level EH and minimum level EL

according to the optical displacement meter 1 of this inventionThe number of the comparators to be used is also two sufficientwithout requiring the accuracy of a comparatorsince the range of the voltage which does not need to form many comparators like before and is compared is being fixed.

[0021]Drawing 3 is what showed the entire configuration figure of the optical displacement meter 1 shown in drawing 2attaches the numerals same about the portion and identical parts which were shown in the conventional displacement gage 100 and the above-mentioned example of important section compositionand omits explanation.

[0022]In the above-mentioned optical displacement meter 1drawing 4 is what showed the detailed example of composition at the time of setting the variable set number of the amplification factor of the variable amplifiers 12 and 13 to 2attaches the numerals same about the portion and identical parts which were shown in the conventional displacement gage 100 and the above-mentioned example of important section compositionand omits explanation.

[0023]The level discrimination section 10 comprises the comparators 10A and 10B and the resistance R10-R12.

If the summed signal outputted from the adder circuit 113 exceeds the maximum level EHIf the output level of the comparator 10A is set to "L" and a summed signal falls from minimum level EL converselyThe output level of the comparator 10B is set to "L"and when a summed signal is larger than minimum level EL and smaller than the maximum level EHthe signal of the "H" level is outputted from the both sides of the comparators 10A and 10B.

[0024]The amplification factor control section 11 comprises NOT circuits 11a and 11bNAND circuits 11c and 11dRS flip flop 11eand 11 f of D flip-flops. In this amplification factor control section 11as shown in (a) - (g) of drawing 5when 11 f of D flip-flops are reset (Q bar output is "H")FET (F1) of the variable amplifier 12 (13) flowsand the amplification factor is reduced.

In this stateeven if the discrimination signal of the "L" level is outputted from the

comparator 10A of the level discrimination section 10 exceeding the maximum level EHa summed signalIt is prevented by NAND circuit 11cand a signal is not transmitted to the D-flip-flop 11f sidebut the amplification factor of the variable amplifier 12 (13) is reduced.
Howeverif a summed signal falls from minimum level EL and the discrimination signal of the "L" level is outputted from the comparator 10BThe signal of the "H" level is inputted into 11 f of D flip-flops through NOT circuit 11b11 d of NAND circuitsand RS flip flop 11eIf a clock signal is inputted from the oscillating circuit 101 in this state11 f of D flip-flops will be set (Q output is "H")FET (F1') of the variable amplifier 12 (13) flowsand an amplification factor is increased.
[0025]It is an amplification factor changeover sectionwhen setting out of an amplification factor is automatically performed by the control mentioned above when the change-over switch 14a was switched to the point of contact a and it switches to the point of contact bit is fixed in the state where an amplification factor is highand converselywhen 14 is switched to the point of contact cit is fixed in the state where an amplification factor is low.
[0026]Nextalthough the operation of (a) - (c) of drawing 6 until it is what had and showed the position detection method of the optical displacement meter of this invention according to claim 3 for the time chartit outputs modulated light towards an object from a light emitting device and it receives the catoptric light by an object by a position detecting element is the same as that of the conventional displacement gageIn this invention methodeach of the position signal of the couple outputted from a position detecting elementIn [amplify with the amplification factor selected from two or more amplification factors set up discretely beforehandsearch for an error integration signalcomparing the summed signal of the position signal of the amplified couple with predetermined reference leveland] the input timing of a clock signalIf this error integration signal is over the predetermined maximum level EHwill make the amplification factor of the position signal of a couple increase from the present amplification factor by one stepand converselyif this error integration signal is falling from

predetermined minimum level ELNegative feedback control is made to be performed so that the amplification factor of the position signal of a couple may be reduced by one step from the present amplification factor. For this reasonsince the error integration signal of the position signal of a couple enters in the window level which always becomes settled in a maximum level and a minimum levelA summed signal can be conjointly stabilized with optical feedback loop controlthe breadth of a dynamic range can be stoppedand the arithmetic precision for the amount calculation of displacement can be raised.

[0027]Drawing 7 is what showed the example of important section composition of the optical displacement meter 2 of this invention indicated to claim 4gives the same numerals to the conventional optical displacement meter 100 and identical parts which were mentioned aboveand omits explanation. In a figure20 is an error integration circuit which integrates with the error component as compared with reference level ER which was able to define beforehand the summed signal outputted from the adder circuit 113.

The acquired error integration signal is making the optical feedback loop form so that it may be transmitted to the modulation circuit (un-illustrating) side and the level of a summed signal may be stabilized in a predetermined value while being added to the level discrimination circuit 21 mentioned later.

21 is a level discrimination section with the comparator 21A which outputs a discrimination signal when the error integration signal outputted from an error integration circuit exceeds the maximum level EHand the comparator 21B which outputs a discrimination signal when an error integration signal falls from minimum level EL. The resistance R1 which connects the variable amplifier 23 (24) to the amplifying circuit 23a (24a)R2R3 ... It has come to be able to carry out the switch setting of the amplification factor discretely by carrying out the one drive of FET (F1F2F3 ... Fn) by which Rn was respectively connected to series selectively.

[0028]When 22 is an amplification factor control section with the rotary switch 22a shown equivalent and a clock signal is inputtedIf the discrimination signal is

outputted from the comparator 21A exceeding the maximum level EHan error integration signalThe control signal to which the amplification factor which switches the rotary switch 22a and is set up now is made to increase by one step is simultaneously sent out to the variable amplifiers 23 and 24On the contraryif an error integration signal falls from minimum level EL and the discrimination signal is outputted from the comparator 21Bsend out simultaneously the control signal which reduces the amplification factor set up now by one step to the variable amplifiers 23 and 24but. If an error integration signal is between minimum level EL and the maximum level EH and the discrimination signal is not outputted from the level discrimination section 21operation which makes the amplification factor set up now without switching the rotary switch 22a hold as it is is performed.

[0029]Thuslike [according to the optical displacement meter 2 of this invention] the optical displacement meter 1 mentioned above with the two comparators 21A and 21B of the level discrimination section 21. Since the error integration signal outputted from the error integration circuit 20 is supervising entering between the maximum level EH and minimum level ELThe number of the comparators to be used is also two sufficientwithout requiring the accuracy of a comparatorsince the dynamic range of the voltage which does not need to form many comparators and is compared is being fixed.

[0030]Drawing 8 is what showed the entire configuration figure of the optical displacement meter 2 shown in drawing 7attaches the numerals same about the portion and identical parts which were shown in the conventional displacement gage 100 and the above-mentioned example of important section compositionand omits explanation.

[0031]In the above-mentioned optical displacement meter 2drawing 9 is what showed the detailed example of composition at the time of setting the variable set number of the amplification factor of the variable amplifiers 23 and 24 to 2attaches the numerals same about the portion and identical parts which were shown in the conventional displacement gage 100 and the above-mentioned

example of important section compositionand omits explanation.
[0032]The level discrimination section 21 comprises the comparators 21A and 21Bthe resistance R20R21and R22.
If the error integration signal outputted from the error integration circuit 20 exceeds the maximum level EHIf the output level of the comparator 21A is set to "L" and an error integration signal falls from minimum level EL converselyThe output level of the comparator 21B is set to "L"and when an error integration signal is larger than minimum level EL and smaller than the maximum level EHthe signal of the "H" level is outputted from the both sides of the comparators 21A and 21B.

[0033]The amplification factor control section 22 comprises NOT circuits 22a and 22bNAND circuits 22c and 22dRS flip flop 22eand 22 f of D flip-flops.
About the operationsince it is the same as that of the amplification factor control section 11 of the displacement gage 1 mentioned aboveexplanation is omitted.

[0034]In this displacement gage 2are making it reversed and connection of the comparators 21A and 21B of the level discrimination section 21and NOT circuits 22a and 22b of the amplification factor control section 22 by this. If an error integration signal increasesan amplification factor will be made to increaseand if an error integration signal fallsit is made to make the negative feedback control which reduces an amplification factor performed conversely.
[0035]NOT circuit 26FET27and the voltage follower circuit 28 which were connected to the oscillating circuit 101Only the period when the oscillation pulse is outputted is controlling so that the error integration signal outputted from the error integration circuit 20 is transmitted to the modulation circuit 102 side and feedback control is performed.
[0036]Like the amplification factor changeover section 14 mentioned aboveif the change-over switch 25a is connected to the point of contact athe amplification factor changeover section 25The change of an amplification factor is

automatically performed by the control mentioned aboveand when it connects with the point of contact bit is fixed in the state where an amplification factor is highand converselywhen it connects with the point of contact cit is fixed in the state where an amplification factor is low.

[0037]

[Effect of the Invention]Since control is automatically performed so that it may always enter in a predetermined window levelaccording to the position detection method of this invention according to claim 1the summed signal of the position signal of the couple outputted from a position detecting elementso that I may be understood from the above explanationIt can become possible to press down the dynamic range of a summed signaland the arithmetic precision for calculation of the amount of displacement can be raised. According to the optical displacement meter of this invention according to claim 2the easy composition which uses two general-purpose comparators enables it to perform highly precise displacement measurement processing by using the method according to claim 1. According to the position detection method of this invention according to claim 3an error integration signal is searched forcomparing with reference level the summed signal of the position signal of the couple outputted from a position detecting elementSince control is automatically performed so that the error integration signal searched for may always enter in a predetermined window levelit can become possible to press down the dynamic range of a summed signal conjointly with the optical feedback loopand the arithmetic precision for calculation of the amount of displacement can be raised. According to the optical displacement meter of this invention according to claim 4the easy composition which uses two general-purpose comparators enables it to perform highly precise displacement measurement processing by using the method according to claim 3.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1](a) - (c) is a time chart explaining this invention method according to claim 1.

[Drawing 2]It is an example figure of important section composition of the optical displacement meter of this invention according to claim 2.

[Drawing 3]It is a detailed example figure of composition of the optical displacement meter of this invention according to claim 2.

[Drawing 4]In the optical displacement meter shown in drawing 3it is a detailed example figure of composition in case the amplification factor of a variable amplifier is two steps.

[Drawing 5](a) - (g) is a time chart explaining operation of the amplification factor control section of the optical displacement meter shown in drawing 4.

[Drawing 6](a) - (c) is a time chart explaining this invention method according to claim 3.

[Drawing 7]It is an example figure of important section composition of the optical displacement meter of this invention according to claim 4.

[Drawing 8]It is a detailed example figure of composition of the optical displacement meter of this invention according to claim 4.

[Drawing 9]In the optical displacement meter shown in drawing 7it is a detailed example figure of composition in case the amplification factor of a variable amplifier is two steps.

[Drawing 10]It is an example figure of composition of the conventional optical displacement meter.

[Drawing 11]It is an explanatory view of the variable amplifier of operation.

[Drawing 12](a) - (c) is a time chart explaining operation of the optical displacement meter shown in drawing 10.

[Description of Notations]

104 ... Light emitting device (laser diode)

105 ... Position detecting element

12 ... Optical displacement meter

12132324 ... Variable amplifier

113 ... Adder circuit

1021 ... Level discrimination section

1122 ... Amplification factor control section

ER ... Reference level

20 ... Error integration circuit

EH ... Maximum level

EL ... Minimum level